High and Low Tide Waterbird Use of the Cullinan Ranch Restoration

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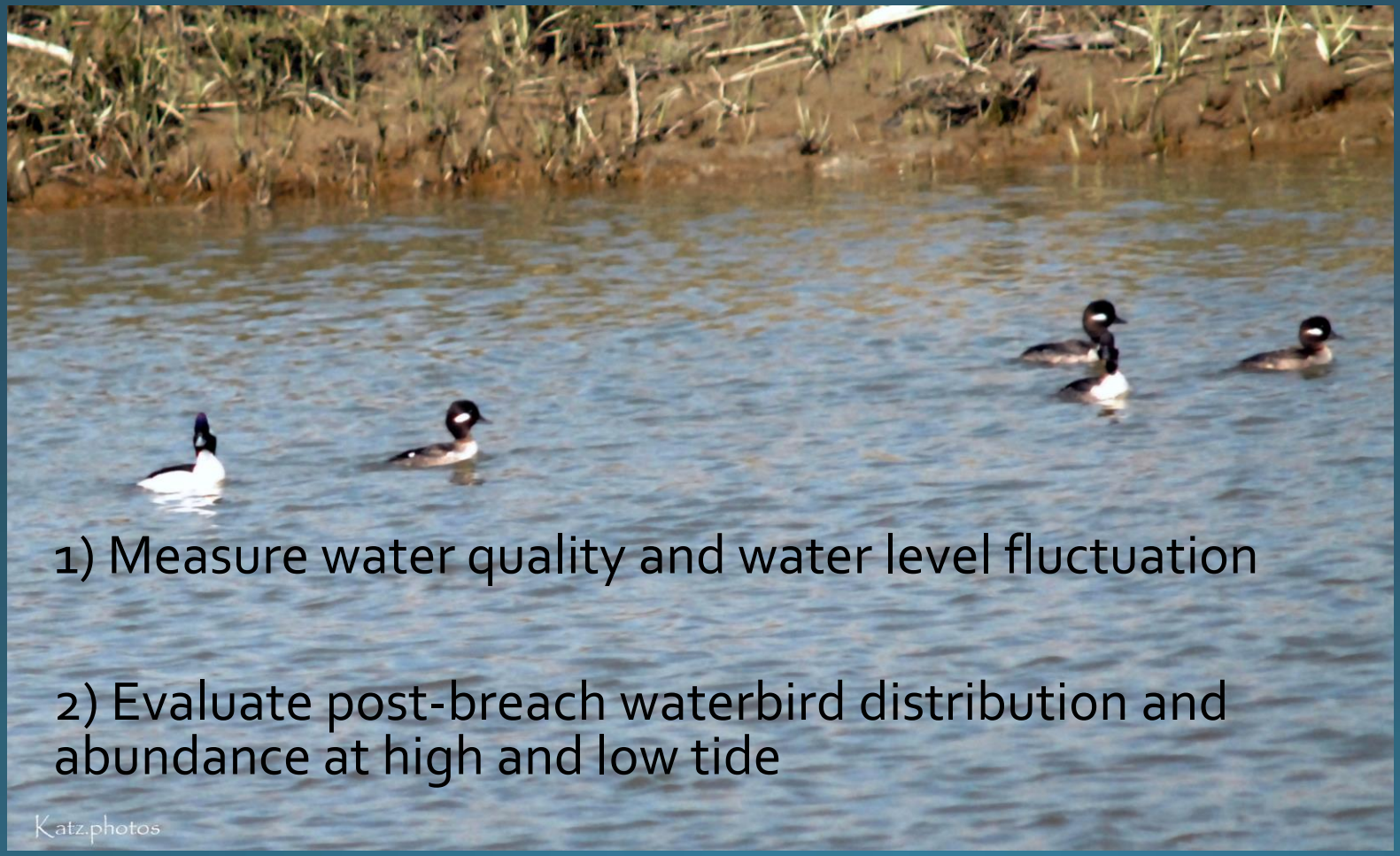
Objectives



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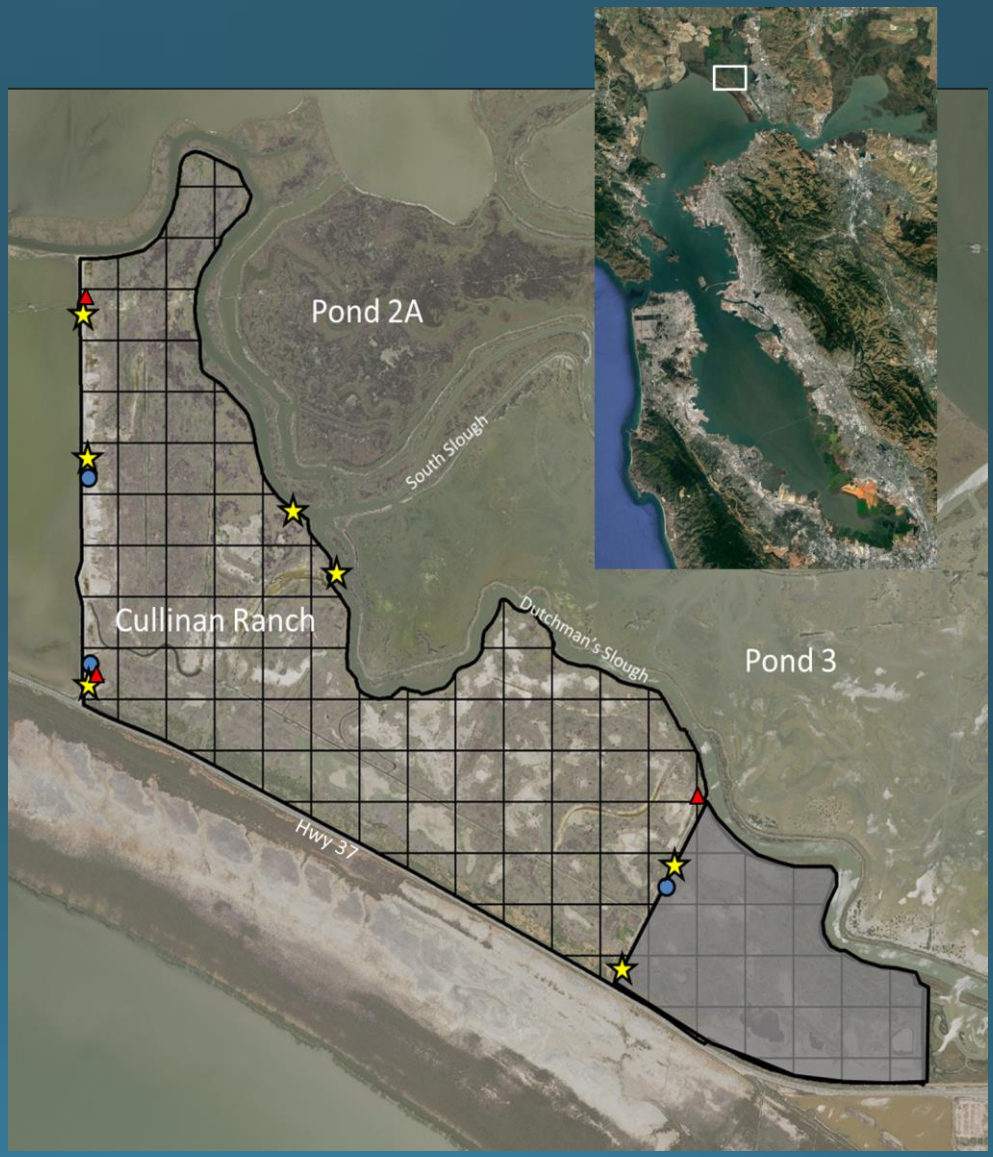
Methods

- 2016 - 2018
- Fall (Nov), Winter (Jan – Feb), Spring (April)
- High (>4.0 ft) and Low (<2.0 ft) tide waterbird surveys
- Continuous water level, salinity, temp
- Surface (<1 m) water quality during waterbird surveys



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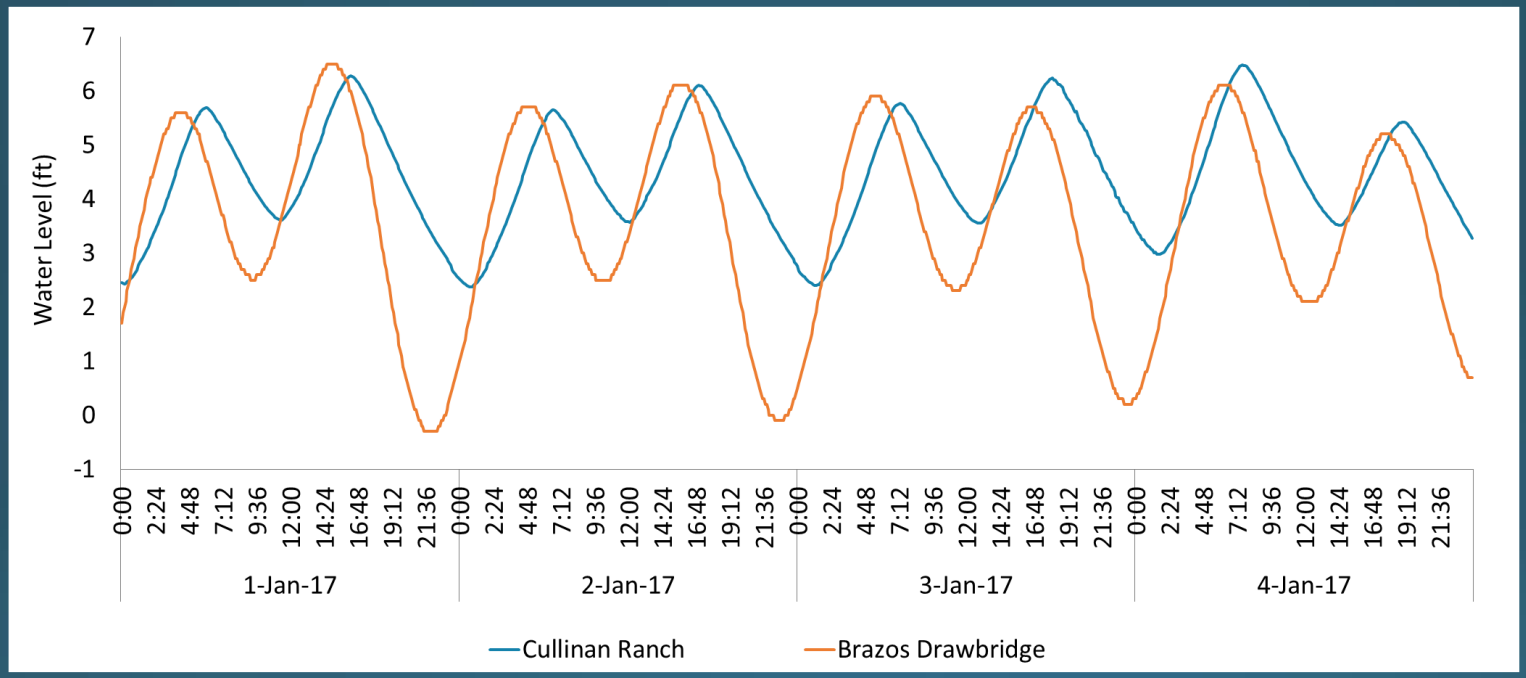
Water level



- Pond tides approximately an hour later than predicted Brazos Bridge
- At high tide, water level in the pond showed a similar trend to predicted values
- Low tide water levels consistently higher than predicted at Brazos Bridge
- Water never dropped below 2.2 ft (relative to sea level), in most areas of the pond

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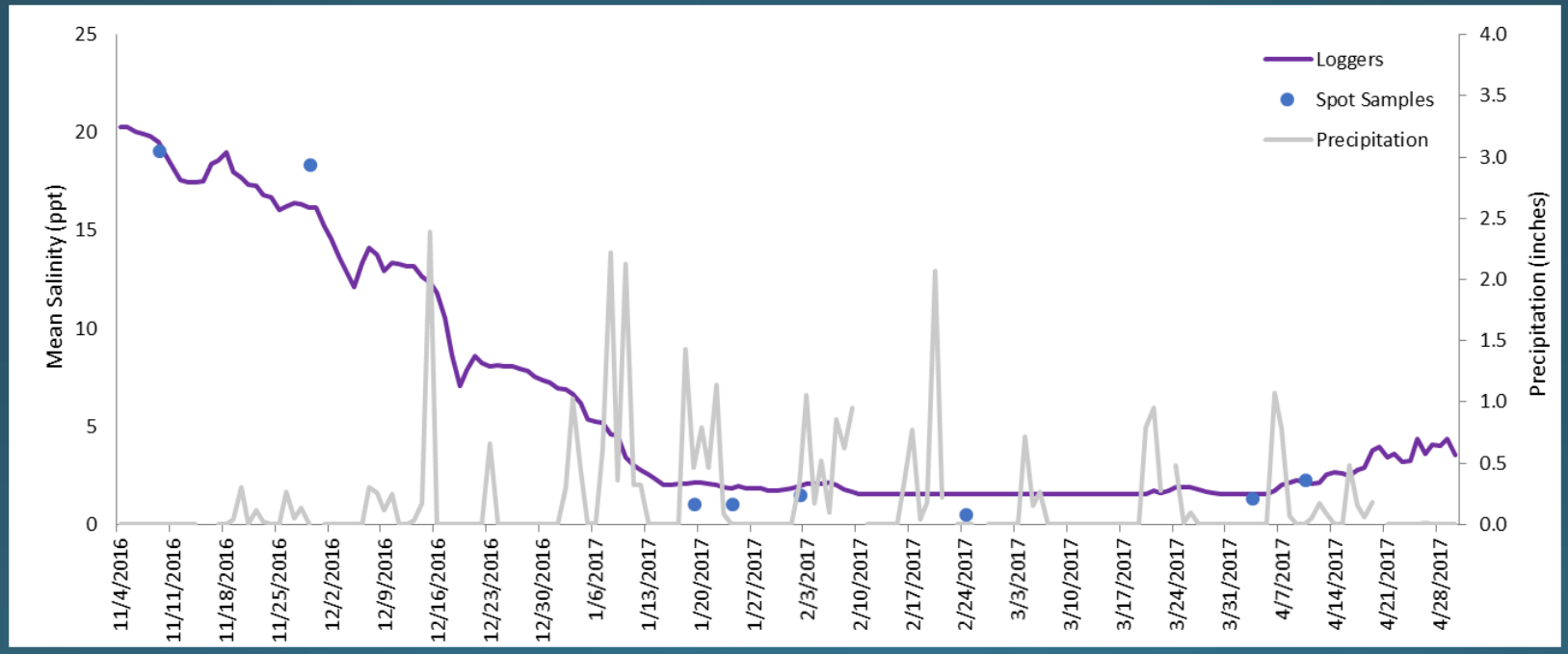
Salinity



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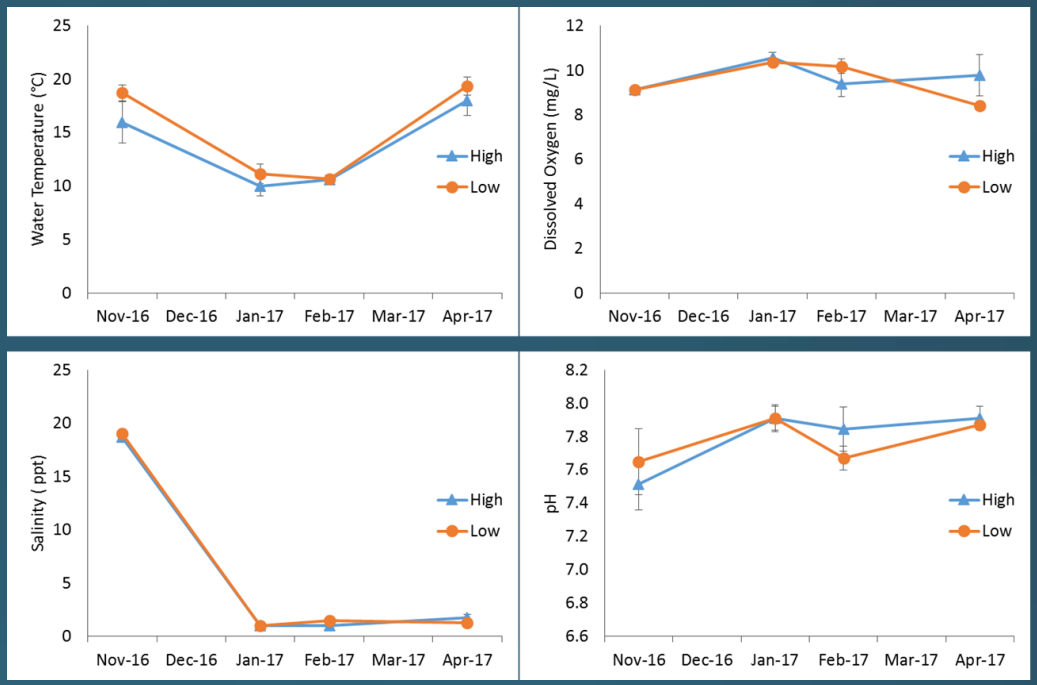
Water quality



		Water Temperature (°C)				Salinity (ppt)				DO (mg/L)				pH			
Year	Month	Mean	SE	Min	Max	Mean	SE	Min	Max	Mean	SE	Min	Max	Mean	SE	Min	Max
2016	Nov	14.2	0.05	6.6	18.6	17.9	0.04	13.8	21.5	9.1	0.07	8.8	9.3	7.5	0.11	7.3	7.9
	Dec	8.7	0.03	2.1	12.3	10.7	0.06	5.0	16.7	-	-	-	-	-	-	-	-
2017	Jan	8.9	0.02	3.2	11.2	3.7	0.04	1.6	7.6	10.6	0.18	10.1	11.2	7.9	0.06	7.8	8.1
	Feb	11.7	0.03	7.9	15.9	2.0	0.01	1.6	2.3	9.4	0.40	8.4	10.6	7.8	0.09	7.5	8.1
	Mar	14.3	0.04	9.6	21.0	1.8	0.01	1.6	2.1	-	-	-	-	-	-	-	-
	Apr	15.9	0.04	9.3	24.5	3.1	0.03	1.6	5.7	9.8	0.66	8.2	12.1	7.9	0.05	7.8	8.1

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Overall waterbird abundance (2017)

- Diving ducks most abundant guild (68%), at both HT (67%), and at LT (69%)
- Canvasback as the most abundant species in total (38%)
- Dabbling ducks were the second most abundant guild across the study (21%), and at both high (15%) and low (28%) tides
- At HT, small shorebirds 14% of total abundance, LT 2%
- All other guilds combined accounted for < 4% of the total abundance at either tidal cycle.

	Nov-16		Jan-17		Feb-17		Apr-17		Total	
Bird Species	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**
Dabbling Ducks	1692	2559	121	480	72	230	102	69	1987	3338
American Coot	1666	2122	61	325	23	118	38	42	1788	2607
American Green-winged Teal	0	68	0	70	9	35	0	0	9	173
American Wigeon	4	325	21	33	29	71	57	23	111	452
Gadwall	0	20	2	7	0	0	7	2	9	29
Mallard	5	6	2	0	2	0	0	0	9	6
Northern Pintail	17	18	35	43	9	0	0	2	61	63
Northern Shoveler	0	0	0	2	0	6	0	0	0	8
Diving Ducks	5252	2890	2237	2786	836	2375	319	266	8644	8317
Bufflehead	198	4	24	8	0	24	3	1	225	37
Canvasback	2336	1658	1295	1979	450	1668	23	27	4104	5332
Common Goldeneye	0	0	0	2	0	3	0	0	0	5
Redhead	0	0	0	2	0	0	0	1	0	3
Ruddy Duck	2625	1209	915	759	275	589	100	142	3915	2699
Unidentified Scaup	93	19	3	36	111	91	193	95	400	241
Eared Grebes	**2**	**1**	**4**	**1**	**0**	**2**	**1**	**0**	**7**	**4**
Eared Grebe	2	1	2	1	0	2	1	0	5	4
Horned Grebe	0	0	2	0	0	0	0	0	2	0
Piscivores	**38**	**50**	**12**	**8**	**5**	**5**	**6**	**5**	**61**	**68**
Clark's Grebe	3	0	7	0	1	0	3	1	14	1
Double-crested Cormorant	14	46	0	0	2	1	1	1	17	48
Pied-billed Grebe	19	3	0	0	1	0	0	0	20	3
Western Grebe	2	1	5	8	1	4	2	3	10	16
Geese	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**8**	**8**	**8**
Canada Goose	0	0	0	0	0	0	8	8	8	8
Gulls	**3**	**1**	**4**	**2**	**3**	**1**	**1**	**0**	**11**	**4**
California Gull	3	0	2	0	0	0	0	0	5	0
Glaucous-winged Gull	0	0	**0**	1	0	1	0	**0**	0	2
Herring Gull	0	1	1	0	1	0	0	0	2	1
Ring-billed Gull	0	0	1	0	0	0	1	0	2	0
Unidentified gull	0	0	0	1	0	0	0	0	0	1
Western Gull	0	0	0	0	2	0	0	0	2	0
Herons & Egrets	**27**	**8**	**105**	**56**	**163**	**22**	**51**	**58**	**346**	**144**
Black-crowned Night-Heron	21	1	105	55	159	19	46	58	331	133
Great Blue Heron	1	0	0	0	0	1	0	0	1	1
Great Egret	3	6	0	0	3	1	0	0	6	7
Snowy Egret	2	1	0	1	1	1	5	0	8	3
Medium Shorebirds	**10**	**18**	**2**	**0**	**11**	**9**	**2**	**0**	**25**	**27**
American Avocet	0	0	2	0	9	3	0	0	11	3
Black-bellied Plover	2	0	0	0	1	0	0	0	3	0
Greater Yellowlegs	0	1	0	0	0	0	0	0	0	1
Long-billed Curlew	0	1	0	0	0	0	0	0	0	1
Marbled Godwit	2	2	0	0	0	2	0	0	2	4
Willet	6	14	0	0	1	4	2	0	9	18
Raptors	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**1**
Northern Harrier	1	0	0	0	0	1	0	0	1	1
Small Shorebirds	565	185	452	0	157	1	641	2	1815	188
Dunlin	28	22	97	0	4	0	1	0	130	22
Least Sandpiper	247	148	180	0	55	1	20	0	502	149
Semipalmated Plover	0	0	0	0	0	0	0	2	0	2
Short or Long-billed Dowitcher	0	0	0	0	1	0	0	0	1	0
Western Sandpiper	290	15	175	0	97	0	0	0	562	15
Western Sandpiper or Dunlin	0	0	0	0	0	0	620	0	620	0
Terns	**0**	**1**	**0**	**0**	**0**	**0**	**63**	**35**	**63**	**36**
Caspian Tern	0	1	0	0	0	0	62	27	62	28
Forster's Tern	0	0	0	0	0	0	1	8	1	8
Total	**7590**	**5713**	**2937**	**3333**	**1247**	**2646**	**1194**	**443**	**12968**	**12135**

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Dabbler and diver distributions

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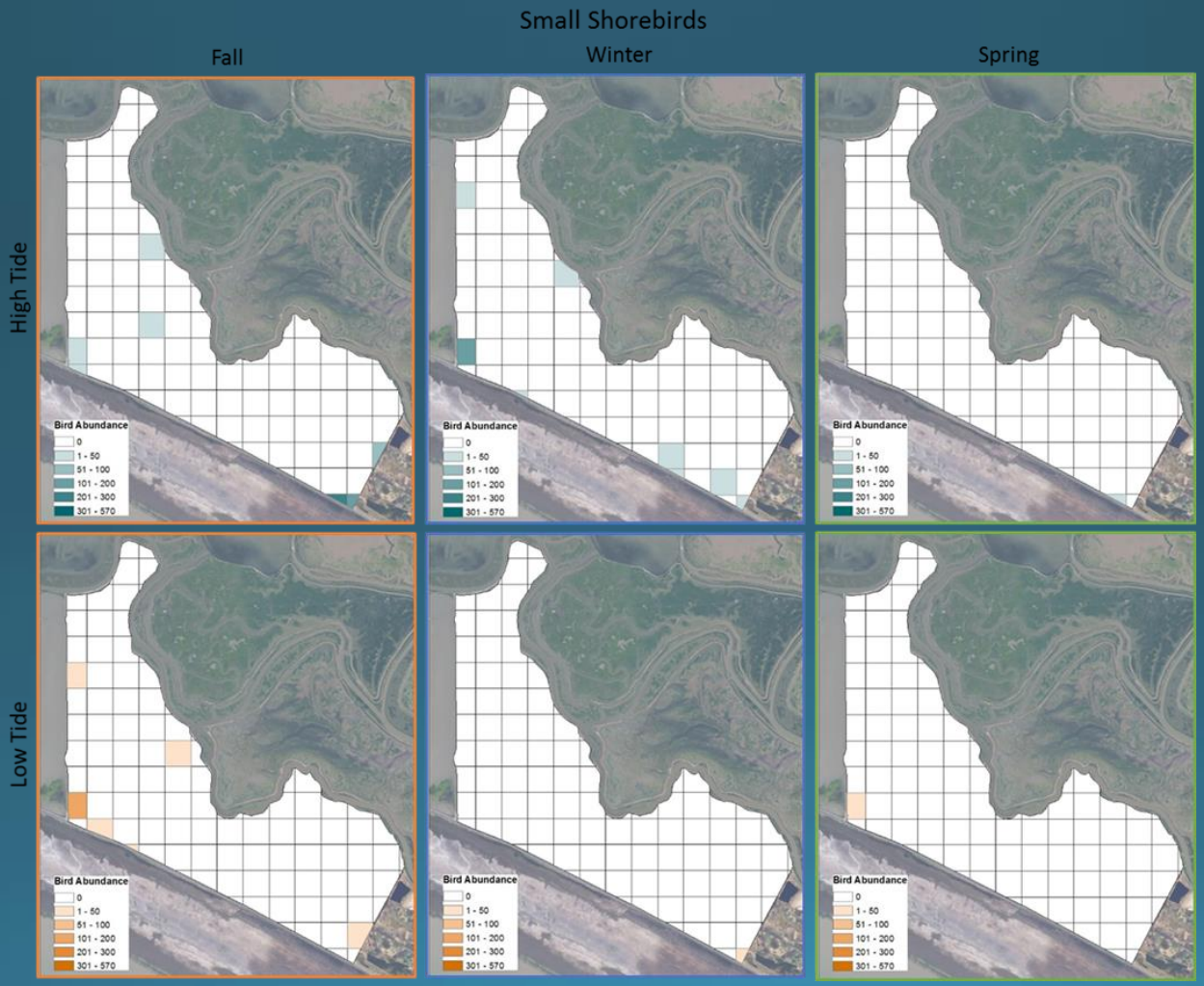
Small shorebird distributions



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High and low tide abundances

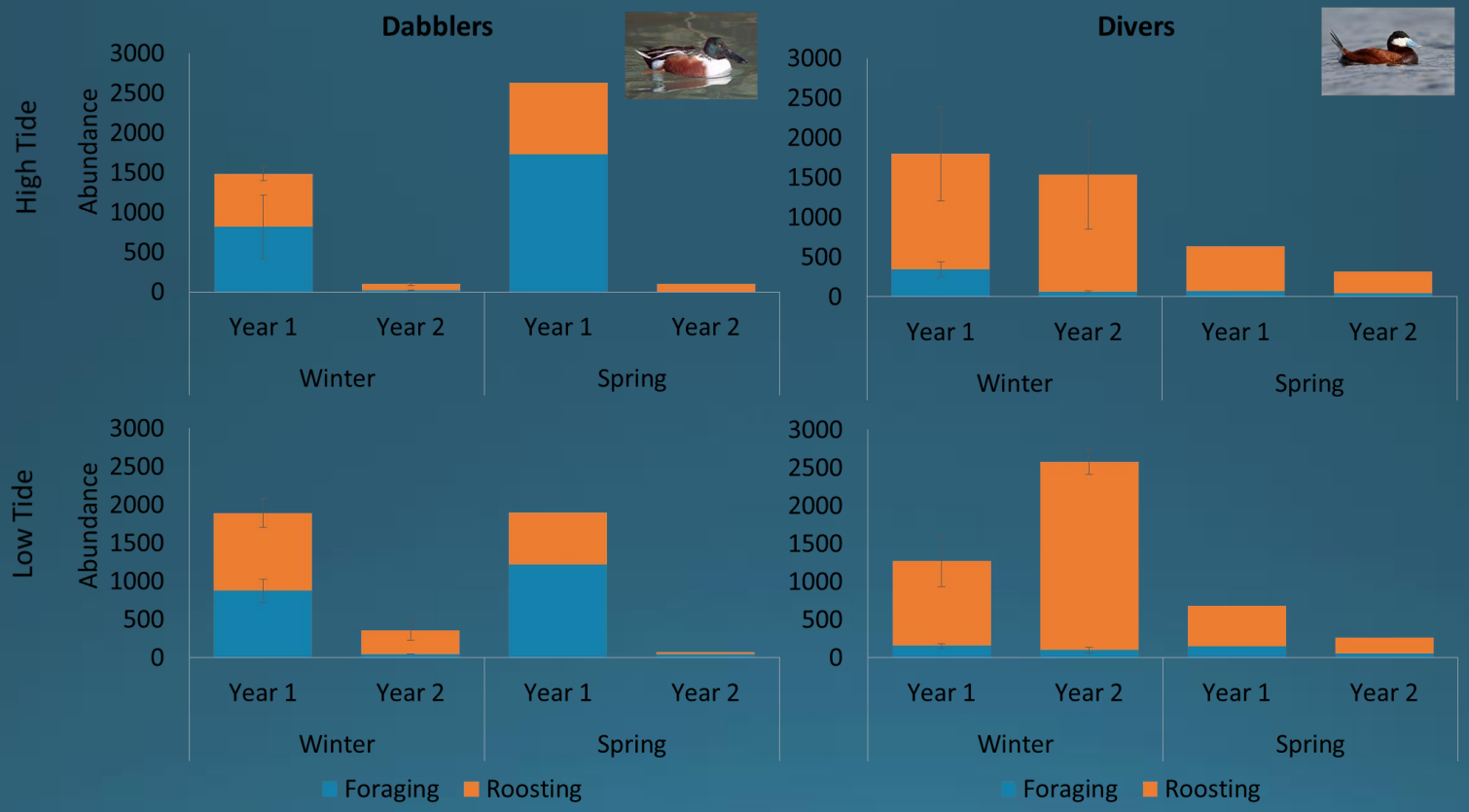

Fig. 2. Seasonal abundance (mean ± SE), of foraging (blue), and roosting (orange), dabbling ducks (left column), and diving ducks (right column), at high (top row), and low (bottom row) tides at Cullinan Ranch in Year 1 compared to Year 2. Spring abundances were observed during a single survey in each year so no SE is shown.

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Preliminary abundance analyses

	Foraging							
	Dabbler				Diver			
Fixed Effect	Estimate	SE	Z value	p	Estimate	SE	Z value	p
Intercept	6.875	0.414	16.594	**<0.001**	4.921	0.290	16.993	**<0.001**
Study Year: 2	-5.009	0.831	-6.032	**<0.001**	-1.319	0.397	-3.320	**0.001**
Season: Winter	-0.150	0.524	-0.286	0.775	0.411	0.348	1.182	0.237
Tide: Low	1.397	0.560	2.494	**0.013**	-0.088	0.237	-0.372	0.710
Total rainfall in prior 30 days	0.087	0.090	0.973	0.330	0.051	0.054	0.946	0.344

	Roosting							
	Dabbler				Diver			
Fixed Effect	Estimate	SE	Z value	p	Estimate	SE	Z value	p
Intercept	735.790	96.177	7.650	**<0.001**	5.914	0.275	21.478	**<0.001**
Study Year: 2	-688.266	155.160	-4.436	**<0.001**	-0.534	0.489	-1.093	0.274
Season: Winter	-33.095	123.400	-0.268	0.789	1.108	0.327	3.389	**0.001**
Tide: Low	130.036	108.070	1.203	0.229	0.060	0.252	0.239	0.811
Total rainfall in prior 30 days	7.137	19.284	0.370	0.711	0.090	0.061	1.474	0.140

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Future work

- Analysis of bathymetry, coupled with sediment deposition study, would allow prediction of vegetation colonization rates and transition to tidal marsh
- Study of prey availability at the site would help estimate carrying capacity for waterbirds and could help managers better understand and manage for the needs of waterfowl and shorebirds
- Movement and habitat use studies to help understand how Cullinan fits into the larger habitat mosaic in Napa-Sonoma Marsh and other parts of the Bay

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Movement studies

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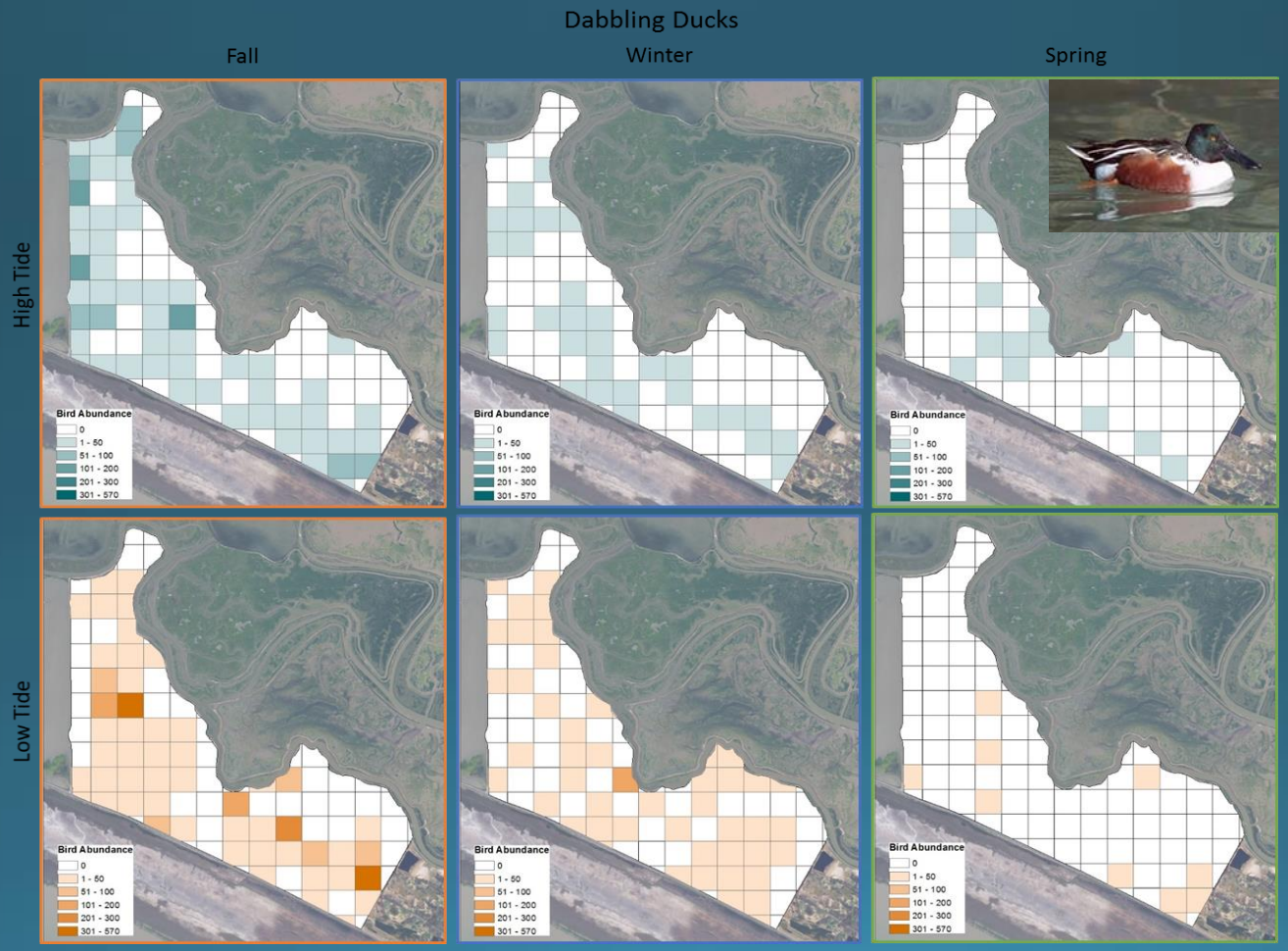
Dabbling duck distribution



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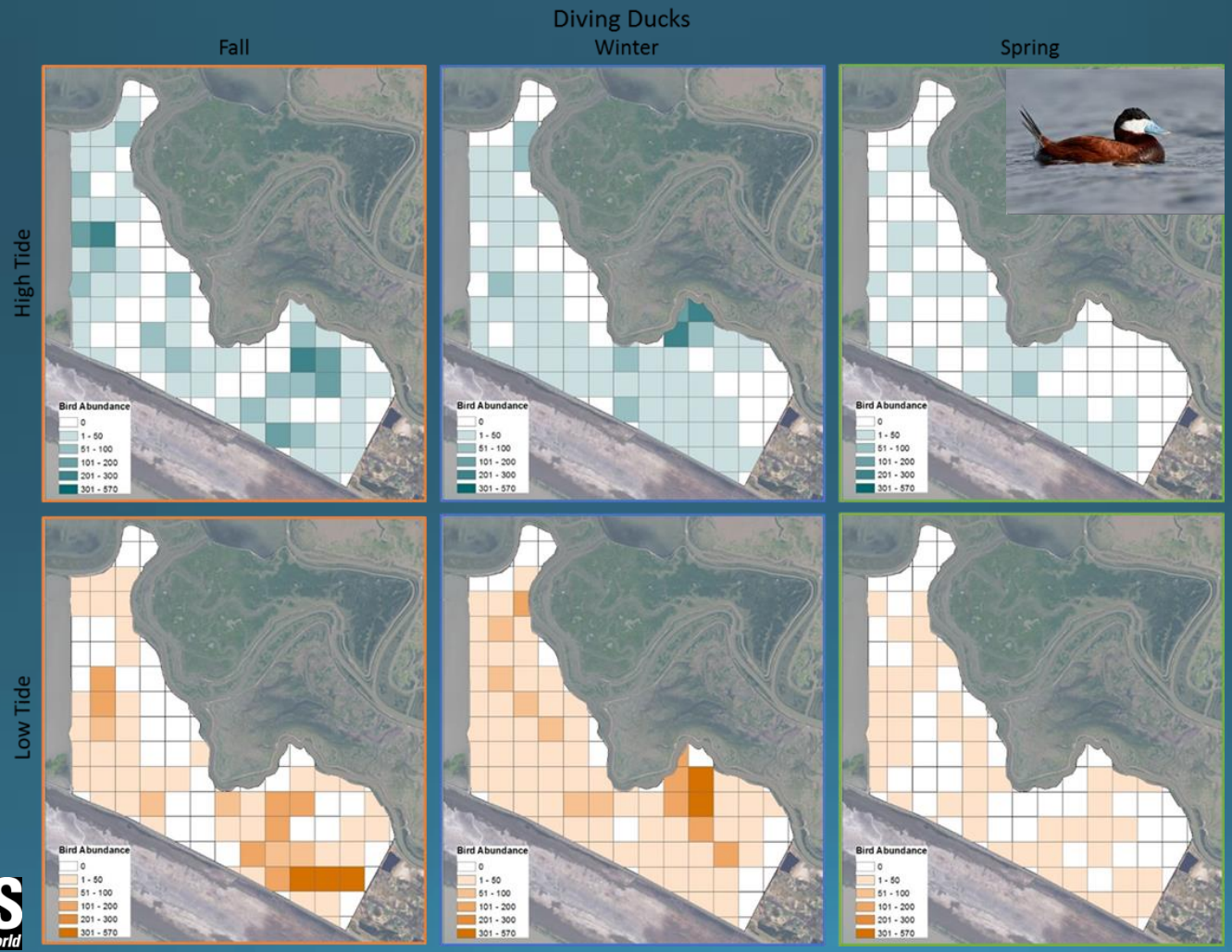
Diving duck distributions



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